

## REMARKS

This application has been reviewed in light of the Office Action dated May 31, 2007. Claims 1-17 are pending in the application. By the present amendment, Claims 1, 2, 7, 16, and 17 have been amended. No new matter has been added. The Examiner's reconsideration of the rejection in view of the amendment and the following remarks is respectfully requested.

Claims 1-17 stand rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter.

As set forth in MPEP 2106.01:

Descriptive material can be characterized as either "functional descriptive material" or "nonfunctional descriptive material." In this context, "functional descriptive material" consists of data structures and computer programs which impart functionality when employed as a computer component.

...

... When functional descriptive material is recorded on some computer-readable medium, it becomes structurally and functionally interrelated to the medium and will be statutory in most cases since use of technology permits the function of the descriptive material to be realized.

Accordingly, each of Claims 1 and 2 recite, *inter alia*, "A three dimensional model re-parameterization computer system". Further, each of Claims 1 and 2 have been amended to now further recite, *inter alia*, "a re-parameterization process, recorded on a computer readable medium". Moreover, Claim 2 has been amended to now even further recite, *inter alia*, "one or more Catmull-Clark models, recorded on a computer readable medium". Thus, given that Claims 1 and 2 both relate to a computer system and both include functional material (re-

parameterization process in both Claims 1 and 2, and additionally the Catmull-Clark models in Claim 2), with that functional material “recorded on a computer readable medium”, it is believed that Claims 1 and 2 satisfy 35 U.S.C. §101.

Moreover, in view of the preceding, Claim 17 has been amended to now recite:

A computer program product comprising a computer useable medium having computer readable program code embodied therein for surface re-parameterization of a surface around extraordinary vertices of a computer three dimensional Catmull-Clark model, ~~the computer program product having a method stored on one or more computer memory medium, the computer program product~~ comprising:

program code for re-parameterizing of one or more subdivision surfaces of the Catmull-Clark model with a plurality of vertices and at least one extraordinary and that has iso-parameter lines with spacing that is different than an original natural spacing, as the iso-parameter lines approach the vertex.

Thus, given that Claim 17 relates to a computer program product comprising a computer useable medium having computer readable program code embodied therein, with the computer program product comprising program code for re-parameterizing as set forth therein, it is believed that Claim 17 satisfies 35 U.S.C. §101.

Regarding Claims 7 and 16, it is respectfully asserted that said claims are directed to the statutory categories of process (Claim 7 recites a method) and machine (Claim 16 recites a system), respectively.

Moreover, to clarify the tangible result provided by the subject matter of said claims, Claim 7 has been amended to now recite, *inter alia*, “at least one of storing the

iso-parameter lines with the new spacing and displaying the iso-parameter lines with the new spacing”, and Claim 16 has been amended to now recite, *inter alia*, “at least one of memory means for storing the iso-parameter lines with the new spacing and display means for displaying the iso-parameter lines with the new spacing”.

Thus, given that Claims 7 and 16 relates to statutory categories and provide a tangible result by at least one storing and/or displaying the iso-parameter lines with the new spacing in the case of Claim 7 and at least one of memory means and display means for storing and displaying the iso-parameter lines with the new spacing, it is believed that Claims 7 and 16 satisfy 35 U.S.C. §101.

It is to be noted that support for the preceding amendments to Claims 1, 2, 7, 16, and 17 may be found at least at page 11, line 20 to page 13, line 13 of the Applicants’ specification.

Accordingly, reconsideration of the rejections under 35 U.S.C. §101 is respectfully requested.

Claims 1-8 and 10-17 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,108,006 to Hoppe (hereinafter “Hoppe”) in view of “Exact Evaluation of Catmull-Clark Subdivision Surfaces at Arbitrary Parameter Values” to Jos Stam (hereinafter “Stam”).

It is respectfully asserted that none of the cited references, either taken singly or in a proper combination, teach or suggest the following limitations recited in independent Claim 1:

a re-parameterization process, recorded on a computer readable medium, that re-parameterizes one or more Catmull-Clark models to create a re-parameterized model, each of the Catmull-Clark models having one or more

extraordinary vertices and one or more adjacent iso-parameter lines that have a natural spacing that changes, the re-parameterized model having iso-parameter lines with a new spacing that is different than the natural spacing as the lines approach the extraordinary vertex.

It is respectfully asserted that none of the cited references, either taken singly or in a proper combination, teach or suggest the following limitations recited in independent Claim 2:

one or more Catmull-Clark models, recorded on a computer readable medium, each of the models having one or more surfaces and one or more extraordinary vertices, where one or more adjacent iso-parameter lines have a natural spacing between them that changes as the iso-parameter lines approach the extraordinary vertex; and

a re-parameterization process, recorded on the computer readable medium, that re-parameterizes the model so that one or more of the extraordinary vertices have adjacent iso-parameter lines with a new spacing that is different than the natural spacing as the lines approach the extraordinary vertex.

It is respectfully asserted that none of the cited references, either taken singly or in a proper combination, teach or suggest the following limitations recited in independent Claim 7:

A method for surface re-parameterization of a surface around extraordinary vertices of a computer three-dimensional Catmull-Clark model with a plurality of vertices, at least one extraordinary vertex, and iso-parameter lines with a natural spacing, the method comprising the step of:

re-parameterizing one or more subdivision surfaces of the Catmull-Clark

model around one or more of the extraordinary vertices into a re-parameterized surface with a new spacing that is different than the natural spacing as the iso-parameter lines approach the extraordinary vertex; and

at least one of storing the iso-parameter lines with the new spacing and displaying the iso-parameter lines with the new spacing.

It is respectfully asserted that none of the cited references, either taken singly or in a proper combination, teach or suggest the following limitations recited in independent Claim 16:

means for re-parameterizing of one or more subdivision surfaces of the Catmull-Clark model with a plurality of vertices and at least one extraordinary and that has iso-parameter lines with spacing that is different than an original natural spacing, as the iso-parameter lines approach the vertex; and

at least one of memory means for storing the iso-parameter lines with the new spacing and display means for displaying the iso-parameter lines with the new spacing.

It is respectfully asserted that none of the cited references, either taken singly or in a proper combination, teach or suggest the following limitations recited in Claim 17:

program code for re-parameterizing of one or more subdivision surfaces of the Catmull-Clark model with a plurality of vertices and at least one extraordinary and that has iso-parameter lines with spacing that is different than an original natural spacing, as the iso-parameter lines approach the vertex.

Initially, it is respectfully asserted that the combination of Hoppe and Stam is improper, since Stam teaches away from Hoppe. Moreover, it is respectfully asserted that the combination is improper since the proposed modification would render the prior art unsuitable for its intended purpose, which is prohibited under MPEP §2143.01. Further, it is respectfully asserted that the combination is improper since the proposed modification would change the principle of operation of a reference, which is prohibited under MPEP §2143.01.

With respect to the first assertion of the Applicants, namely that Stam teaches away from Hoppe, the Applicants point out that Hoppe is directed to a “Method and System for View-dependent Refinement of Progressive Meshes” (Hoppe, Title) that involves re-parameterization (i.e., that involves explicit subdivision)(see, e.g., Hoppe, col. 3, lines 14-25, and lines 52-65, respectively disclosing a method and system involving re-parameterization), while Stam is directed to the “Exact Evaluation of Catmull-Clark Subdivision Surfaces at Arbitrary Parameter Values” (Stam, Title) that explicitly proscribes the use of re-parameterization (i.e., that proscribes the use of explicit subdivision)(see, e.g., Stam, Abstract).

As set forth in MPEP §2141.02 “A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984)”.

Further, as set forth in MPEP 2143.01:

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some

teaching, suggestion, or motivation to do so >. *In re Kahn*, 441 F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006) (discussing rationale underlying the motivation-suggestion-teaching requirement as a guard against using hindsight in an obviousness analysis). The teaching, suggestion, or motivation must be found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art.

Here, Stam explicitly discloses “we disprove the belief widespread within the computer graphics community that Catmull-Clark subdivision surfaces cannot be evaluated directly without explicitly subdividing” (Stam, Abstract), thus explicitly teaching away from Hoppe's approach of re-parameterization. Thus, Hoppe teaches re-parameterization, while Stam teaches natural parameterization and notes that his natural parameterization approach is against widespread belief that such natural parameterization can even be used to evaluate Catmull-Clark subdivision surfaces in the first place.

Accordingly, where one reference teaches re-parameterization (Hoppe), while the other reference explicitly teaches away from re-parameterization (Stam), the latter going so far as to characterize the impossibility of evaluating Catmull-Clark subdivision surfaces without explicitly subdividing as a widespread belief in the computer graphics community, it is respectfully asserted that such references explicitly teach away from each other and, hence, no teaching, suggestion, or motivation exists to support a combination of Hoppe and Stam. Accordingly, the combination formed from such references is improper for at least these reasons.

With respect to the second assertion of the Applicants, namely that the proposed modification would render the prior art unsuitable for its intended purpose as prohibited by MPEP §2143.01, the Applicants point out that Hoppe is directed to re-parameterization, while Stam is explicitly directed to natural parameterization. Accordingly, the combination of Hoppe and Stam renders each reference unsuitable for its respective intended purpose. That is, Hoppe's intended purpose relates to re-parameterization of subdivision surfaces, while Stam's intended purpose relates to the natural parameterization of subdivision surfaces. Hence, given the completely distinct and opposing intended purposes of each of the references, it is respectfully asserted that the combination of Hoppe and Stam would render such references unsuitable for their intended respective purposes, as proscribed by MPEP §2143.01. Accordingly, the combination formed from such references is improper for at least this reason.

With respect to the third assertion of the Applicants, namely that the proposed modification would change the principle of operation of a reference as prohibited by MPEP §2143.01, the following text of MPEP §2143.01 is provided:

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959) (Claims were directed to an oil seal comprising a bore engaging portion with outwardly biased resilient spring fingers inserted in a resilient sealing member. The primary reference relied upon in a rejection based on a combination of references disclosed an oil seal wherein the bore engaging portion was reinforced by a cylindrical sheet metal casing. Patentee taught the device required rigidity for operation, whereas the claimed invention required resiliency. The court reversed



the rejection holding the “suggested combination of references would require a substantial reconstruction and redesign of the elements shown in [the primary reference] as well as a change in the basic principle under which the [primary reference] construction was designed to operate.” 270 F.2d at 813, 123 USPQ at 352.).

The Applicants point out that the principle of operation of Hoppe is re-parameterization, while the principle of operation of Stam is natural parameterization. Accordingly, the combination of Hoppe and Stam would necessarily involve a change of operation of Hoppe and Stam, which is prohibited under MPEP §2143.01. Accordingly, the combination formed from such references is improper for at least this reason.

Thus, the Applicants respectfully assert that no proper combination has been cited against independent Claims 1, 2, 7, 16, and 17 that teaches all the limitations recited in said claims.

“To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art” (MPEP §2143.03, citing *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)).

Accordingly, independent Claims 1, 2, 7, 16, and 17 are patentably distinct and non-obvious over the cited references for at least the reasons set forth above.

“If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious” (MPEP §2143.03, citing *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)).

Claims 3-6 depend from Claim 1 and, thus, includes all the elements of Claim 1. Claims 8-15 depend from Claim 7 or a claim which itself is dependent from Claim 7 and, thus,

includes all the elements of Claim 7. Accordingly, Claims 3-6 and 8-15 are patentably distinct and non-obvious over the cited references for at least the reasons set forth above with respect to Claims 1 and 7, respectively.

Moreover, said dependent claims include patentable subject matter in and of themselves and are, thus, patentable distinct and non-obvious over the cited references in their own right.

For example, none of the cited references teach or suggest “where derivatives evaluated at one or more parameter values of one or more limit surfaces of subdivision of the Catmull-Clark model approach zero as one or more parameter positions approach the extraordinary vertex”, as recited in Claim 3. The Examiner has acknowledged that Hoppe does not disclose the limitations of Claim 3, but cited Equation 6, and pages 5-6 of Stam as disclosing the same. The Applicants respectfully disagree. Stam discloses how to compute derivatives based on the natural parameterization. There is a big difference between simply computing derivatives for computation sake and computing the derivatives in a STABLE WAY (see, e.g., Applicants’ specification, p. 11, lines 7-11). One problem with computing derivatives based on natural parameterization (versus the claimed approach) is that the derivatives obtained from the Stam approach may “blow up” as one gets close to the vertex, which would render them unusable for any practical purpose. Accordingly, it is respectfully asserted that none of the cited references teach or suggest the above-recited limitations of Claim 3.

Moreover, none of the cited references teach or suggest “where the new spacing decreases as the iso-parameter lines approach one or more of the extraordinary vertices”, as recited in Claims 5 and 14. The Examiner has cited Figure 5 items  $f_L$ ,  $f_R$ ,  $F_{N0}$  and  $F_{N2}$  of Hoppe, stating “note that the spacing decreases when the line 112 is inserted”. The Applicants

respectfully disagree. Hoppe does not disclose iso-parameter lines, as claimed. Rather, Hoppe discloses edges of triangles (see, e.g., Figures 5 and 6 of Hoppe). Hoppe merely collapses an edge of a triangle to a single point (see, e.g., Figures 5 and 6 of Hoppe). There are no such edges on parametric surfaces and, therefore, nothing to collapse. Accordingly, it is respectfully asserted that none of the cited references teach or suggest the above-recited limitations of Claims 5 and 14.

Further, none of the cited references teach or suggest the following limitations of Claim 10:

- where the re-parameterizing comprises the following steps:
  - computing a characteristic map corresponding to each of the vertices of a face, being face vertices, of a quadrilateral mesh containing one or more points being evaluated;
  - computing an inverse characteristic map for each of the face vertices; and
  - blending the inverse characteristic maps of the four face vertices to create the re-parameterization.

Also, none of the cited references teach or suggest “where the characteristic map is used to obtain a continuously differentiable parameterization around one or more of the extraordinary vertices”, as recited in Claim 11.

Additionally, none of the cited references teach or suggest “where the inverse characteristic map is computed by locating a layer on the surface and a polynomial patch within that layer that contains the point to be evaluated and then computing a re-

parameterized position of the input point by polynomial patch inversion", as recited in Claim 12.

The Examiner has cited Hoppe as disclosing the preceding limitations of Claims 10, 11, and 12. The Applicants respectfully disagree.

It is respectfully asserted that a characteristic map does not apply in Hoppe and is thus not disclosed therein. Accordingly, neither is an inverse characteristic map disclosed in Hoppe.

Thus, it is respectfully asserted that none of the cited references teach or suggest the above-recited limitations of Claims 10, 11, and 12.

Thus, reconsideration of the rejections under 35 U.S.C. §103 is requested.

In view of the foregoing amendments and remarks, it is respectfully submitted that all the claims now pending in the application are in condition for allowance. Early and favorable reconsideration of the case is respectfully requested.

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It is believed that no additional fees or charges are currently due. However, in the event that any additional fees or charges are required at this time in connection with the application, they may be charged to applicant's IBM Deposit Account No. 50-0510.

Respectfully submitted,

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